

## FRIDAY FLYER – OCT 5, 2012

Something to share—an interesting research project or kudos for a student, teacher or mentor? Contact Kris Whelan.

### **CENTER SPOTLIGHT: Colorado State University -**

<http://hawc.colostate.edu/people/?id=MiguelMostafa>

Contact Miguel Mostafa to find out what it takes to start up a new QuarkNet center.

Colorado State University is our newest QuarkNet center, having just completed year 1. The two lead teachers are Cherie Bornhorst from Loveland High School and Adam Pearlstein from Denver Jewish Day School. Miguel Mostafa is the CSU mentor. This summer the program concentrated on cosmic ray research. Besides building the QuarkNet muon detectors, the teachers built (and taught other teachers how to build) simple cloud chambers for the classroom. They studied some of the released data from the Pierre Auger Observatory and discussed future projects using the High-Altitude Water Cherenkov (HAWC) prototype detector at CSU. In year 2, the lead teachers and mentor plan to include field trips with the QuarkNet detectors. CSU is in a unique location surrounded by mountains up to 12,000 ft. in elevation. They will measure muon flux as a function of zenith angle and as a function of altitude. They will also try to determine if they can measure east-west asymmetries and will try to complement the QuarkNet counters with their water Cherenkov detector there.

The focus of CSU's research program includes both the Pierre Auger and the HAWC Observatories. Auger is a large international collaboration (18 countries) located in Argentina, and HAWC, currently under construction, is binational between Mexico and the U.S. In Auger, a large public data set is available. CSU is the U.S. mirror of these data, and they hope to get the teachers involved in developing studies and research exercises for their students. In HAWC, CSU is also unique in that they have the only off-site, full-size detector prototype. This is a 5-meter-tall water Cherenkov detector. It holds 50,000 gallons of pure water and has seven upward-facing PMTs (six 8" and one 10") at the bottom along with muon counters buried under the large volume of water, and one counter on top for coincidences and trigger studies. It also includes a laser calibration system, temperature probes, water level probe, and more. Mentor Miguel Mostafa calls it "the perfect toy." In the years ahead they will study how to combine their studies with this prototype with the QuarkNet detectors.

CSU has a large outreach program called the Little Shop of Physics (LSOP). This year, one of the lead teachers went with them to an Indian reservation and took one of the QuarkNet detectors. It was a huge success. They will apply for one more detector to be deployed at the reservation next year. The QuarkNet center will continue to tag along with the LSOP as they go to other areas of the state, and neighboring states too. This will be a very exciting addition to the QuarkNet program.

### **Resource of the week**

<http://quarknet.fnal.gov/download/RollingWithRutherford.pdf>

This new segment will provide teachers with links and descriptions of QuarkNet curriculum materials. For this week, we spotlight the "Rolling with Rutherford" activity. Using marbles as "probe" balls and "target" balls, students are introduced to the concept of indirect measurement and data analysis.

### **Physics Experiment Roundup**

**Construction begins on largest liquid-argon time projection chamber in the U.S.**

[http://www.fnal.gov/pub/today/archive\\_2012/today12-10-04\\_tpcReadmore.html](http://www.fnal.gov/pub/today/archive_2012/today12-10-04_tpcReadmore.html)

In 2014, Fermilab will begin the MicroBooNE experiment to study neutrinos. This is another

example of work that physicists will be able to do even though the Tevatron has been retired. (from Fermilab *Today*, Oct. 4, 2012)

### **Just For Fun - Particle Zoo**

<http://particlezoo.net/>

Who says you can't have quarks and leptons to study in your own classroom? You can order a variety of plush particles and "theoreticals" to stimulate excitement in your students.

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